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Oaks

(*Quercus* species)

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The oaks are the most important hardwood group in the United States because of the quantity of oak timber available and the strength and beauty of the wood and its fitness for a wide range of uses. In quantity of standing timber, the oak group leads the hardwoods but is considerably below several of the conifers.

The range of growth of the 60 or more species of native oaks extends throughout the United States. Of these, 20 species, all growing in the eastern half of the United States, may be classed as commercially important. In the lumber trade the oaks are divided into two groups, "red oak" and "white oak," and the different species are usually distinguished only according to the group to which they belong. The wood of the white oaks generally lacks the reddish tinge common in the red oaks, and the pores in the heartwood of nearly all the white oaks are filled with a natural membraneous growth which makes the wood less permeable to liquids and more resistant to decay.

Oak is the leading wood for flooring, tight barrels and kegs, and railroad ties, and is extensively used for interior finish, furniture, vehicle parts, ships and boats, boxes and crates, fuel wood, mine timbers, veneer, etc. The bark of chestnut oak has been an important source of tanning materials.

Oak has ranked fourth in lumber production among all woods for many years and first among hardwoods. There was a downward trend in the production of oak lumber from 1909 to 1941 partly because of the substitution of other materials or woods for oak and the increasing difficulty in securing high-grade oak. The cut in 1941 was considerably greater than in 1940 and in 1942 was nearly double that in 1940. This was undoubtedly due to demands brought about by war. In recent years the States in the deep South, where the largest remaining oak stands of saw-timber size are located, have furnished a much greater proportion of the oak lumber than formerly.

Nomenclature.—The generally accepted common names for the various oaks of commercial importance, together with their botanical names, are shown in table 1. Practically all these species are also known by other names in various localities. The white oak group contains 9 species and the red oak group 11.

Distribution and growth.—The oaks of commercial importance in the United States grow east[1] of a line from western Minnesota to western Texas. White oak, chestnut oak, and swamp chestnut oak supply a large proportion of the commercial "white oak" sold on the market. Commercial "red oak" consists largely of northern red oak, southern red oak, swamp red oak, and Shumard oak.

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[1] Bur oak grows west of this line in the northern part of its range.

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WHITE OAK GROUP

White oak (*Quercus alba*) grows over a wide range from Maine to Florida and Minnesota to Texas. (See fig. 1.) It formerly occupied extensive areas of rich arable land in the group of States centering about Kentucky, and trees 400 years old, 6 feet in diameter, and 130 feet high were not uncommon. Forest trees 3 feet in diameter are now rare. The dominance of white oak was due to its longevity and persistence of growth and not to prolific reproduction or rapidity of growth. White oak is largely responsible for the reputation of oak as a high-grade all-purpose wood. Probably none of the other oaks possess the combination of strength, hardness, toughness, ability to stay in place, durability, and beauty of grain to the same degree as does white oak. Clearing of the better land continues to decrease the proportion of white oak in the stands of oaks and increase the more prolific and more rapidly growing (although less persistent and long-lived) red oaks.

TABLE 1.—*Estimated stand of commercial oak saw timber by groups and by species*[1]

White oak group	Estimated stand		Red oak group	Estimated stand	
	Million board feet	*Percent*		*Million board feet*	*Percent*
White oak (*Quercus alba*)	17,100	45	Black oak (*Q. velutina*)	11,900	26
Chestnut oak (*Q. montana*)	6,800	18	Northern red oak[2] (*Q. borealis*)	6,400	14
Post oak (*Q. stellata*)	5,000	13	Southern red oak (*Q. falcata*)	5,900	13
Overcup oak (*Q. lyrata*)	3,000	8	Scarlet oak (*Q. coccinea*)	3,600	8
Swamp chestnut oak (*Q. prinus*)	2,700	7	Water oak (*Q. nigra*)	3,600	8
Bur oak (*Q. macrocarpa*)	1,500	4	Willow oak (*Q. phellos*)	3,200	7
Chinquapin oak (*Q. muhlenbergii*)	1,100	3	Blackjack oak (*Q. marilandica*)	2,300	5
Swamp white oak (*Q. bicolor*)	400	1	Pin oak (*Q. palustris*)	2,300	5
Live oak (*Q. virginiana*	400	1	Swamp red oak (*Q. falcata* var. *pagodaefolia*)	2,300	5
	38,000	100	Shumard oak (*Q. shumardii*)	2,300	5
			Laurel oak (*Q. laurifolia*)	1,900	4
				45,700	100

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[1] 1940. It should be understood that the figures given are only rough estimates subject to change as more definite information becomes available.

[2] Included with northern red oak is the so-called eastern red oak (*Q. borealis maxima*), which some botanists consider a distinct variety of northern red oak. Both of these oaks were formerly known as red oak.

Chestnut oak has a comparatively narrow distribution, from southern New England westward to southern Ohio and Indiana, and southward to Northern Alabama and Mississippi. (See fig. 2.) It grows largely on upper slopes and ridges, where it develops small trees 10 to 20 inches in diameter suitable for ties or lumber for rough construction. On better sites, mature trees reach diameters of 20 to 30 inches and heights of 70 to 80 feet and furnish good saw material cut and sold as white oak. The bark of chestnut oak has been an important source of domestic tannin, but in recent years comparatively small quantities have been used for this purpose.

Post oak grows from Connecticut westward through southern New York and Pennsylvania to Nebraska and southward to northern Florida and the southern part of Texas. (See fig. 3.) As a timber

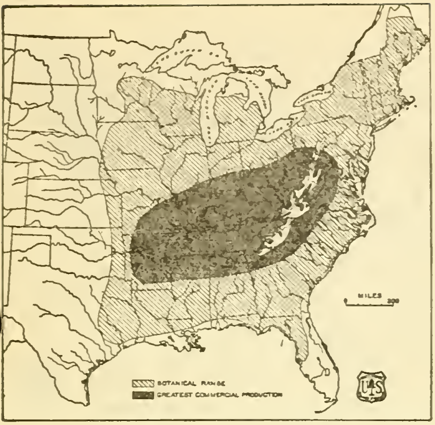

FIGURE 1.—Range of white oak (*Quercus alba*).

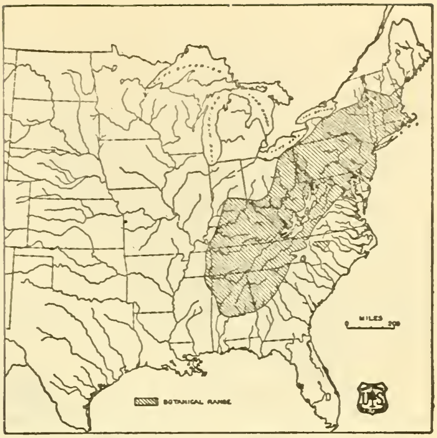

FIGURE 2.—Range of chestnut oak (*Quercus montana*).

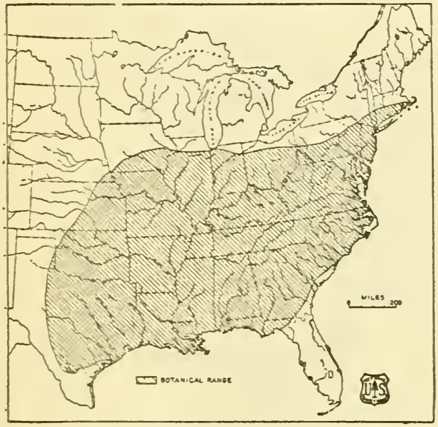

FIGURE 3.—Range of post oak (*Quercus stellata*).

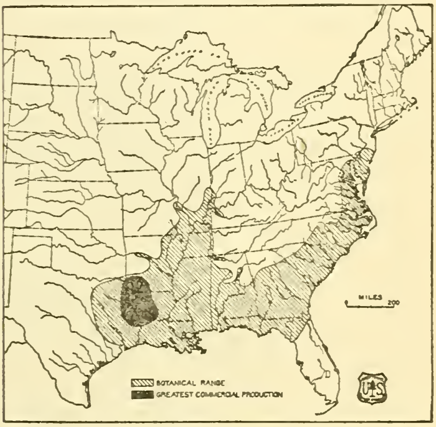

FIGURE 4.—Range of overcup oak (*Quercus lyrata*).

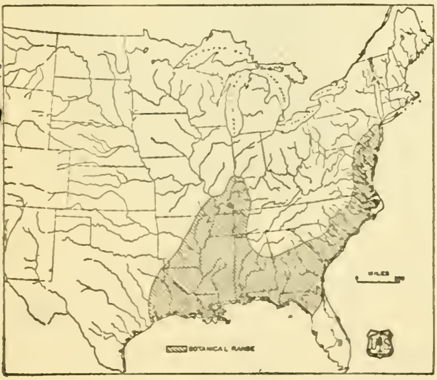

FIGURE 5.—Range of swamp chestnut oak (*Quercus prinus*).

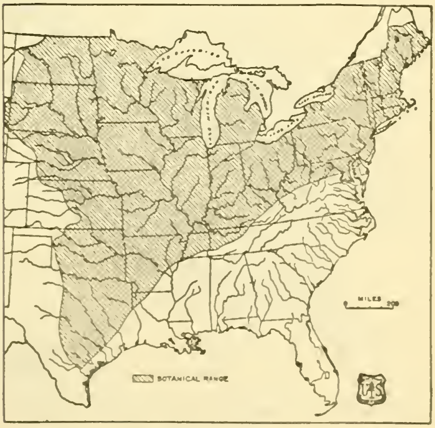

FIGURE 6.—Range of bur oak (*Quercus macrocarpa*).

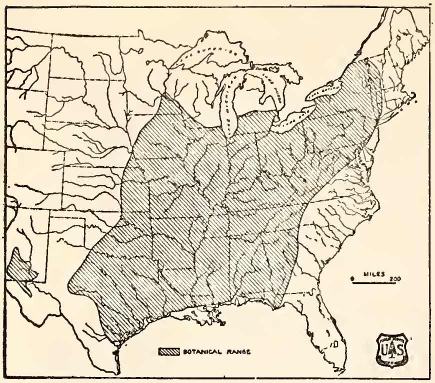

Figure 7.—Range of chinquapin oak (*Quercus muehlenbergii*).

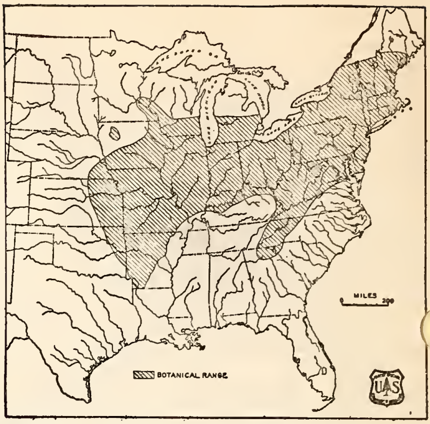

Figure 8.—Range of swamp white oak (*Quercus bicolor*).

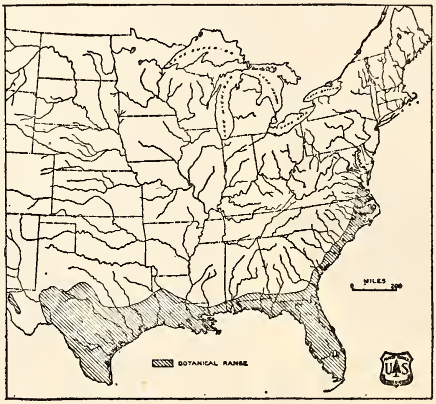

Figure 9.—Range of live oak (*Quercus virginiana*).

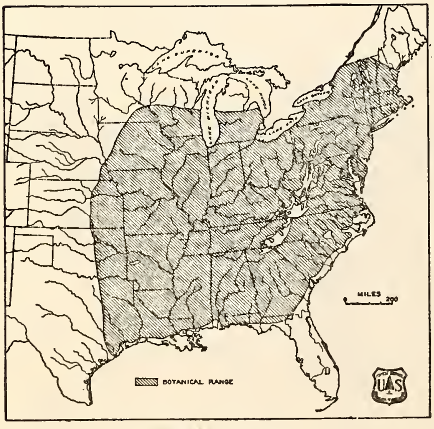

Figure 10.—Range of black oak (*Quercus velutina*).

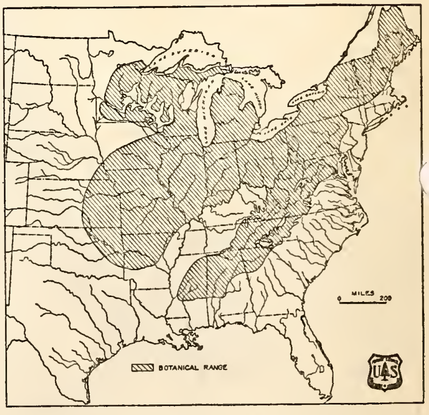

Figure 11.—Range of Northern red oak (*Quercus borealis*; also *Q. borealis maxima*).

tree, it is short-boled and limby and much inferior to white oak, and is cut largely for ties and construction timbers. The trunk is frequently attacked by borers, which render many trees unfit for use as lumber. Mature trees are generally 1 to 2 feet in diameter and 50 to 60 feet high.

Overcup oak and **swamp chestnut oak** both occur commercially from southern Illinois southward throughout the lower Mississippi Valley and in the Atlantic and Gulf coastal plains from Virginia to Texas. (See figs. 4 and 5.) Together these two species make up a considerable proportion of the white oak group in the lower Mississippi Valley States. Overcup oak rarely reaches a diameter of over 3 feet. It often has a short, crooked trunk and is very susceptible to attack by insects. In spite of these defects, trees that will yield usable logs can generally be selected. The wood has a decided tendency to check and warp during seasoning. Swamp chestnut oak is a moderate- to large-sized tree, frequently developing a massive, straight trunk. Mature trees reach diameters of 3 to 7 feet and a height of 100 feet. Swamp chestnut oak has long been one of the most important hardwoods of the Mississippi River Delta region and the supply has been considerably reduced by heavy cutting.

Bur oak occurs chiefly in the upper Mississippi Valley States. Its range extends farther west (to eastern Montana and Wyoming) than any of the other eastern oaks. (See fig. 6.) Under favorable conditions bur oak sometimes reaches a diameter of 6 feet and height of 160 feet. Mature trees average 2 to 3 feet in diameter and 80 to 90 feet high. They frequently have straight trunks clear of branches, but the wood is not considered equal to white oak in quality. Bur oak is used to some extent for structural purposes and railroad ties.

Chinquapin oak grows principally in Missouri, Kentucky, Arkansas, Tennessee, Mississippi, and Alabama. (See fig. 7.) It is usually of secondary importance and is used mainly for ties and rough construction timbers. Mature trees are generally 18 to 20 inches in diameter and 60 to 90 feet high. Much larger trees were once found, especially in the forests of southern Indiana and Illinois.

Swamp white oak grows in very limited amounts on the bottom lands of the Central and Northeastern States and reaches a diameter of 3 feet and height of 80 feet. (See fig. 8.) The wood compares favorably with the best white oak.

Live oak, which is an evergreen species, grows in a narrow belt along the coast from Texas to North Carolina. (See fig. 9.) It is not often cut for commercial purposes. The tree generally has a short bole that divides a few feet above the ground into three or four horizontally spreading branches. It was formerly used largely in shipbuilding for "knees." Live oak has been widely planted in the Southern States as an ornamental tree. It is the heaviest, strongest, and hardest of the oaks.

RED OAK GROUP

Black oak grows from Maine to Georgia and from Minnesota to Texas. The largest supplies are in Tennessee, Arkansas, Kentucky, and Missouri. (See fig. 10.) While the stand of black oak is large and some fine timber is produced under favorable conditions, much of it occurs on poor soils, and the trees are scrubby and too small or too poor in quality for saw timber. Under favorable conditions black oak ordinarily reaches a height of 70 to 80 feet and diameter of 2 to 3 feet.

Northern red oak is the most important of the red oak group from the lumber standpoint. It occurs chiefly from Maine to the mountains of Georgia and Alabama and from Minnesota to Arkansas. (See fig. 11.) West Virginia probably contains the largest stands of saw-timber size, followed by North Carolina and Tennessee. Mature trees are generally 70 to 80 feet high and about 2 feet in diameter.

Southern red oak and **swamp red oak** are botanically very much alike and grow in the Coastal Plain regions from Delaware to Texas and up the Mississippi Valley to Missouri and Illinois. (See figs. 12 and 13.) The largest supplies are found in Arkansas and Louisiana. Southern red oak generally reaches diameters of 2 to 3 feet and heights of 70 to 80 feet when mature. Swamp red oak grows in somewhat larger sizes and produces a larger proportion of high-grade lumber than southern red oak. The wood of swamp red oak also rates higher in strength properties.

Scarlet oak grows in greatest quantities in Pennsylvania, Ohio, and West Virginia. (See fig. 14.) It is found principally on poor soils, and the lumber is in general of lower quality than that from northern red oak. On favorable soils, however, scarlet oak often produces lumber of good quality. Mature trees are generally 70 to 80 feet high and 2 to 3 feet in diameter.

Water oak and **willow oak** grow in the coastal plains from Delaware to Texas and north to southern Missouri. (See figs. 15 and 16.) They are generally found on the borders of streams and swamps. The supply of both is located largely in Arkansas, Louisiana, Mississippi, and Texas. Both reach heights of 80 to 90 feet and diameters of 2 to 3 feet. Pin knots are common in willow oak.

Shumard oak grows in the States bordering on the Atlantic Ocean and the Gulf of Mexico from Maryland to Texas and northward from the Gulf nearly to the Lake States. (See fig. 17.) It is generally found in wet bottom lands and along the borders of streams and swamps. Mature trees grown under favorable conditions reach a diameter of about 4 feet and height of 100 feet. The heavily buttressed trunk is often free of branches for 50 feet and produces lumber of high quality. Trees have been reported 8 feet in diameter and 200 feet high. Shumard oak is most abundant and reaches its largest size in the bottom lands of the Mississippi basin. The timber is of good average quality and is utilized closely wherever found. It is used principally for furniture, cabinet work, and veneer. The tree apparently has no notable defects or enemies.

The other oaks in the red oak group, including blackjack oak, pin oak, and laurel oak, are of less commercial importance. (See figs. 18, 19, and 20.) Blackjack oak generally grows on dry, sandy barrens under conditions which most trees cannot endure. Trees of saw-timber size are rare. The wood is used for fuel and for the manufacture of charcoal and other products of wood distillation. Pin oak and laurel oak grow largely in wet bottom lands and along the borders of streams and swamps. Under favorable conditions they reach a height of 80 to 100 feet and diameter of 2 to 3 feet. The wood of

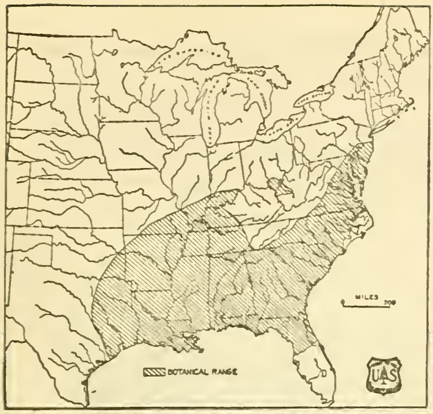

FIGURE 12.—Range of Southern red oak (*Quercus falcata*).

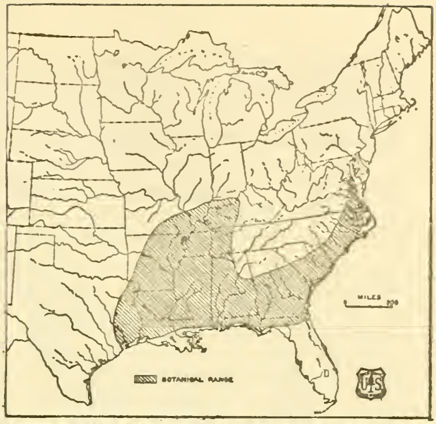

FIGURE 13.—Range of swamp red oak (*Quercus falcata* var. *pagodaefolia*).

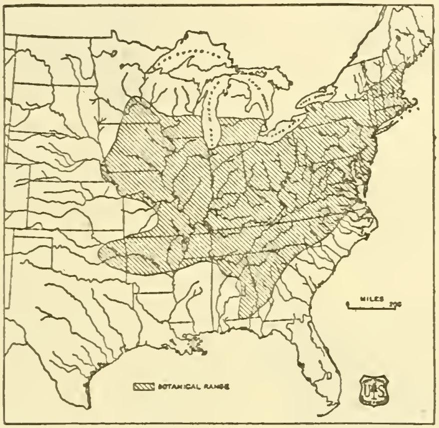

FIGURE 14.—Range of scarlet oak (*Quercus coccinea*).

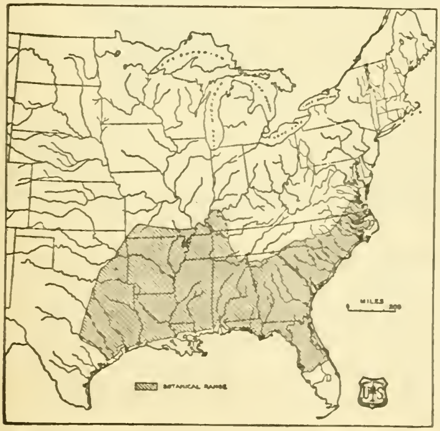

FIGURE 15.—Range of water oak (*Quercus nigra*).

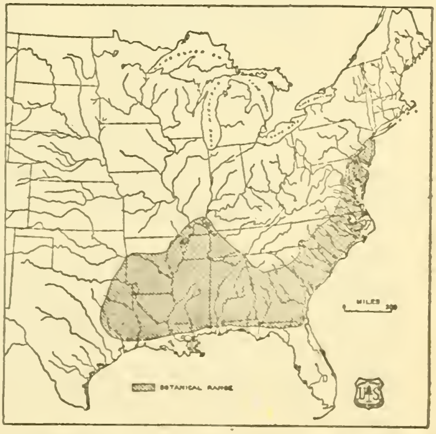

FIGURE 16.—Range of willow oak (*Quercus phellos*).

both species has the reputation of being difficult to season and is used largely for fuel and for distillation purposes.

Supply.—The total stand of oak saw timber in the United States was estimated in 1938 at 83,700,000,000 board feet.[2] The stand of each of the species in the white and red oak groups is roughly estimated in table 1. Estimates of the distribution of the oak stand by regions and the proportions of white and red oak groups in each are shown in table 2.

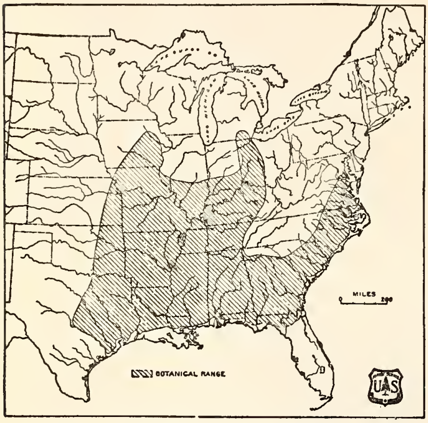

FIGURE 17.—Range of Shumard oak (*Quercus shumardii*).

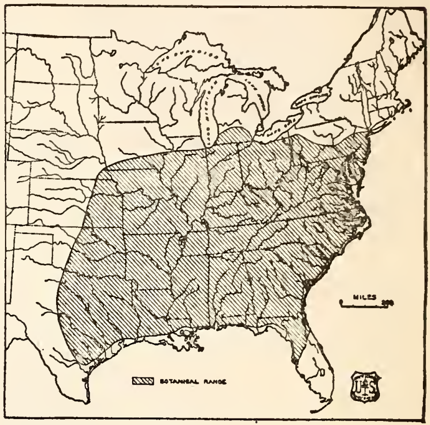

FIGURE 18.—Range of blackjack oak (*Quercus marilandica*).

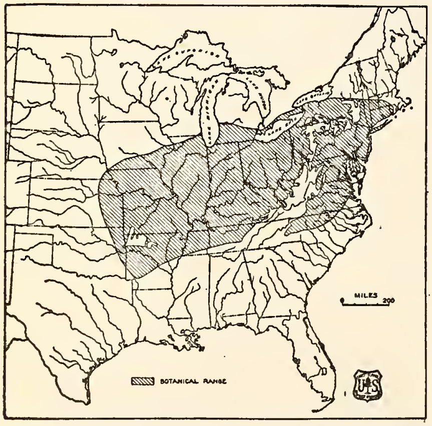

FIGURE 19.—Range of pin oak (*Quercus palustris*).

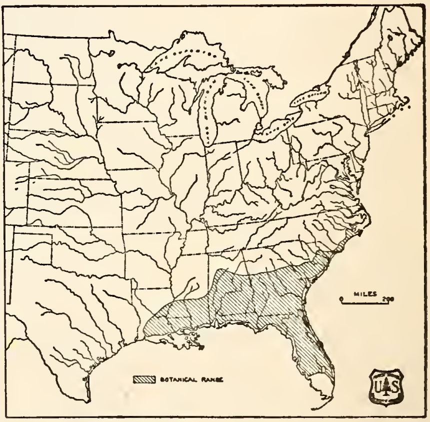

FIGURE 20.—Range of laurel oak (*Quercus laurifolia*).

The total stand of the commercial red oaks is somewhat larger than that of the white oaks, and the difference will probably become more marked in the future, since the white oaks are preferred for most uses. White oak is listed in table 1 as making up approximately 45 percent of the stand of the white oak group in 1940. This proportion is now probably somewhat less. Black oak leads among the commercial red oaks, but much of it is unsuitable for saw timber, and in spite of its larger stand is of considerably less importance as a source of oak lumber than northern red oak.

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[2] UNITED STATES CONGRESS, JOINT COMMITTEE ON FORESTRY. FOREST LANDS OF THE UNITED STATES. 77th Cong., 1st sess., Senate Doc. 32, 44 pp. 1941.

TABLE 2.—*Estimated stand of oak saw timber in eastern United States by regions and states and approximate proportions of white oaks and red oaks* [1]

Region	Stand		Proportion of stand	
			White oaks	Red oaks
	Thousands of board feet	*Thousands of board feet*	*Percent*	*Percent*
Northeast:				
New England:				
Maine	---	[3] 5,831,000		
New Hampshire	---			
Vermont	---			
Massachusetts	---		[2] 21	[2] 79
Rhode Island	---			
Connecticut	---			
Middle Atlantic:				
New York	---			
New Jersey	---			
Pennsylvania	---		[3] 49	[2] 51
Delaware	---			
Maryland	---			
Lake:				
Michigan	1,211,000	[4] 5,298,000	[2] 43	[2] 57
Wisconsin	3,325,000			
Minnesota	762,000			
Central:				
Ohio	---	[2] 7,551,000	[2] 50	[2] 50
Indiana	---			
Illinois	---			
Missouri	---			
Iowa	---			
South:				
Deep South:				
South Carolina (¼)	628,700	[5] 39,132,000	[5] 42	58
Georgia	3,665,400			
Florida	1,368,600			
Alabama	4,307,100			
Mississippi	6,157,100			
Louisiana	9,083,300			
Arkansas	8,193,600			
Oklahoma	727,100			
Texas	5,001,100			
Middle South:				
South Carolina (¾)	---	[6] 25,888,000	[6] 50	[6] 50
North Carolina	---			
Virginia	---			
West Virginia	---			
Kentucky	---			
Tennessee	---			
Total	---	[3] 83,700,000	45	55

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[1] It should be understood that some of the figures given are only rough estimates subject to change as more definite information becomes available. Figures based on International ¼-inch rule.

[2] UNITED STATES CONGRESS, JOINT COMMITTEE ON FORESTRY. FOREST LANDS OF THE UNITED STATES. 77th Cong., 1st sess., Senate Doc. 32, 44 pp. 1941.

[3] Based on a forest survey of the Lake States, completed in 1938, conducted by the Lake States Forest Experiment Station of the Forest Service, U. S. Department of Agriculture, as part of a Forest Survey of the United States.

[4] Based on a forest survey of the Southeastern States completed in 1938, conducted by the Southern Forest Experiment Station of the Forest Service, U. S. Department of Agriculture, as part of a Forest Survey of the United States.

[5] This figure obtained by subtracting the stand in the deep South from the stand in the entire South (deep South plus Middle South) as given in S. Doc. No. 32 (see footnote 2 above).

[6] Based on information supplied by the Appalachian Forest Experiment Station of the Forest Service, U. S. Department of Agriculture.

The largest supplies of oak, especially virgin or old-growth timber, are to be found in the Southeastern States, principally in the deep South. Louisiana, Arkansas, and Mississippi contain 23,434,000,000 board feet, over one-quarter of the estimated stand of oak in the entire United States. As the old-growth timber in the South is cut, the second-growth material in the more northern regions will assume increasing importance. The Forest Survey data indicate that about one-half of the white oak saw timber in the deep South can be classed as high-grade material.

PRODUCTION

Lumber.—Records of the production of oak lumber show a cut of slightly over 2,000,000,000 board feet in 1869. (See fig. 21.) For the next 30 years the cut increased, reaching an all-time maximum of 4,551,000,000 board feet in 1899. Since then, production has decreased irregularly, falling to a minimum of 516,000,000 in 1932. In 1942 production was 2,763,000,000 board feet. It came from 37 States. The average annual cut of oak lumber for the 10-year period 1933–42 was approximately 1,507,000,000 board feet. The 1943 production was 3,038,363 board feet.

The three leading States in the production of oak lumber from 1869–99 were Indiana, Ohio, and Pennsylvania. By 1899 much of their oak timber had been cut, and the center of oak production began to move southward. In 1904 Tennessee, West Virginia, and Kentucky became the leading States and held that position until 1913, when Kentucky was displaced by Arkansas. From 1920 to 1929 Arkansas was first. Louisiana became one of three leaders in 1924 and remained so until 1939 (except in 1932 when it ranked fifth). During the 10-year period 1933–42 Arkansas ranked first five times, Tennessee three times, and Louisiana and Virginia once each. The three leading States in 1942 were Tennessee, Virginia, and West Virginia. They furnished about 27 percent of the total production of oak lumber for that year. Tennessee has been the most consistent producer of oak lumber, ranking among the first three since 1899.[3]

Cross ties.—The number of oak cross ties treated annually with preservatives since 1913 [4] before being placed in service has varied from a maximum of 27,663,000 in 1928 to a minimum of 8,067,000 in 1933.[5] The average during the 10-year period 1933–42 was 17,078,000. If it is assumed that 75 percent of the oak ties used are treated, the total oak ties used annually would be approximately 22,770,000. If it is also assumed that 50 percent of these ties are hewed and 50 percent sawed,[6] then the total hewed oak ties used annually in recent years would be about 11,385,000, equivalent to 338,000,000 board feet.

Fuel wood.—An estimate made in 1933 [7] placed the total amount of fuel wood cut annually at 61,266,000 cords, of which 38,755,000 cords were hardwoods. It is estimated that about one-fifth of this, or approximately 8,000,000 cords, was oak. A large proportion of fuel wood is, of course, unsuitable for sawing into lumber. A rough estimate of the amount of lumber that could be sawed from 8,000,000 cords of oak fuel wood is 600,000,000 board feet.

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[3] Except in 1915, 1938, and 1940 when it was fourth.

[4] 1914 is the earliest year for which statistics on the number of oak ties treated are available.

[5] A year of depression in business.

[6] Sawed ties are classed as lumber and are included in the lumber production figures.

[7] UNITED STATES FOREST SERVICE. A NATIONAL PLAN FOR AMERICAN FORESTRY. 73d Cong., 1st sess., Senate Doc. 12, 2 v. 1933.

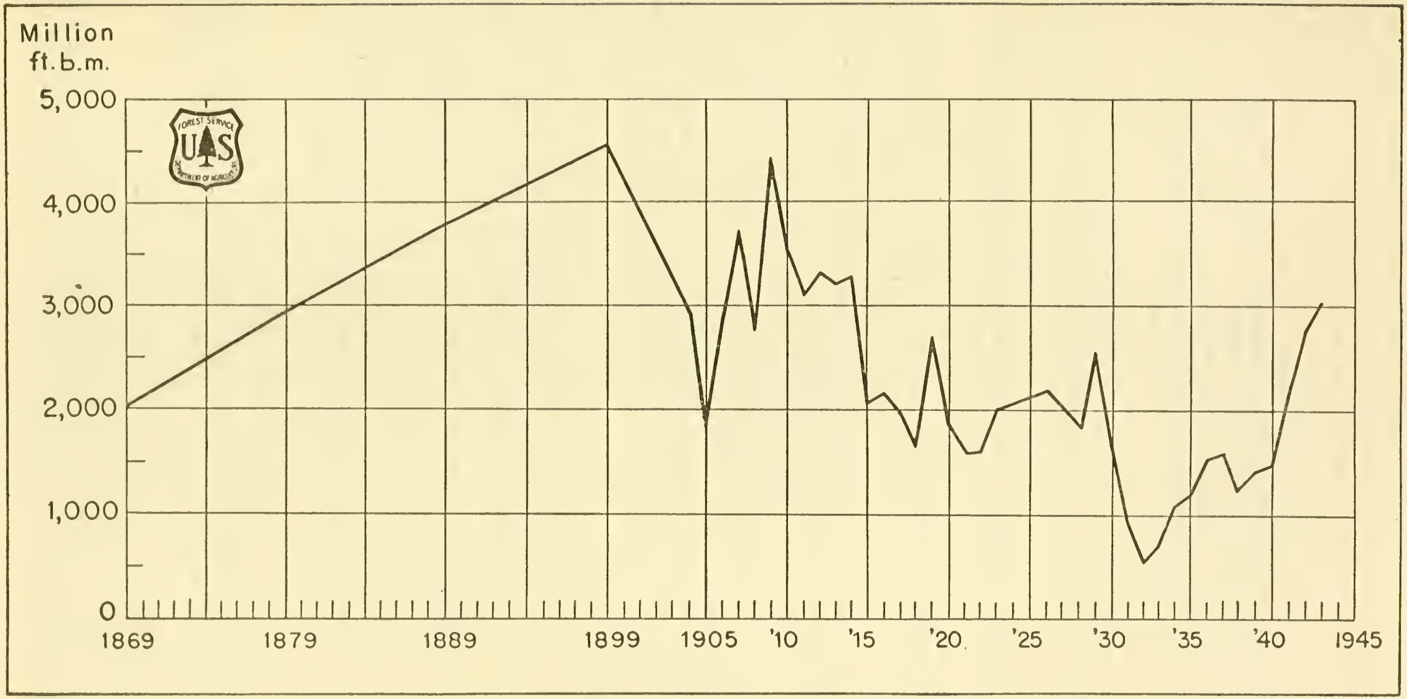

FIGURE 21.—Lumber production of oak (*Quercus* species), 1869–1943.

Cooperage.—The annual production of oak staves and heading for tight barrels has varied widely, with the general trend downward. In 1919 over 216,000,000 oak staves were produced. By 1925 production had dropped to about 59,000,000. In 1939 [8] about 90,000,000 oak staves were produced. The average annual production for the two latest years for which records are available (1931 and 1939) was approximately 85,000,000 oak tight staves. In 1919 nearly 15,000,000 sets [9] of oak tight heading were produced. By 1925 production had dropped to 6,745,000 sets. In 1929 it rose to 20,750,000 sets. The average annual production in recent years is placed at approximately 6,000,000 sets.

In the production of oak staves for slack barrels the trend has been decidedly downward. In 1906 nearly 71,000,000 oak slack staves were produced. By 1935 [10] production had dropped to 2,800,000 staves. The average annual production of oak slack staves in recent years has been about 4,000,000. The output of oak slack heading has also fallen but not to such an extent as that of oak slack staves. The average in recent years has been about 700,000 sets of heading.

Mine timbers.—The consumption of round oak mine timbers increased from about 28 million cubic feet in 1905 to about 54 million cubic feet in 1923. In 1935 [11] consumption dropped to approximately 35 million cubic feet. The average consumption for the last few years is estimated at 30 million cubic feet.

Fence posts.—An estimate made in 1920 gave the number of fence posts cut each year as 900 million.[12] A 1933 recent estimate reduced this figure to approximately 400 million posts of which 250 million were considered to be hardwood.[13] About one-sixth of these or approximately 40 million posts were oak. Only a small proportion of the timber used for fence posts is a possible source of lumber. Probably not more than 20 million board feet of lumber could have been cut from this material.

Veneer.—The quantity of oak logs used for veneer decreased from about 34 million board feet log scale in 1919 to about 8 million board feet in 1935 and rose to 11,653,000 board feet log scale in 1944. The average annual consumption in recent years has been about 10 million board feet log scale.

Other products.—Other material which goes to make up the annual cut of oak timber includes piling, cross arms and brackets for telegraph poles, insulator pins, export logs and timbers, poles, distillation wood, and tanbark. In 1944 fairly large quantities of oak are estimated to have been used for pulpwood. Table 3 lists the approximate annual cut of oak in recent years for various products.

PROPERTIES AND USES

Properties.—The heartwood of the white oaks is generally grayish brown with no reddish tinge, and that of the red oaks brown with a tinge of red. The lighter-colored, whitish sapwood in both the white and red oaks of saw-timber size varies from one to several inches in width. The annual growth rings on a cross section of oak are distinct. Each ring is made up of a band of dense summerwood and a band of lighter colored springwood containing large pores. In the white oaks, the pores of the heartwood are usually plugged with a frothlike growth known as tyloses.[14] In the red oaks these are generally open and provide channels for the ready penetration of liquids. While the wood of the white oaks can be distinguished from that of the red oaks, there is no reliable method of distinguishing the woods of the various white oaks from each other, nor the woods in the red oak group. Oak wood has a striking appearance because of the broad and conspicuous medullary or pith rays which show distinctly in quarter-sawed material.[15]

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[8] The last year for which tight cooperage statistics on oak are available.
[9] A set includes material for top and bottom of barrel.
[10] The last year for which slack cooperage statistics on oak are available.
[11] The last year for which statistics on mine timbers are available.
[12] UNITED STATES FOREST SERVICE. TIMBER DEPLETION, LUMBER PRICES, LUMBER EXPORTS, AND CONCENTRATION OF TIMBER OWNERSHIP. Rpt. on Senate Res. 311, 71 pp. 1920.
[13] UNITED STATES FOREST SERVICE. A NATIONAL PLAN FOR AMERICAN FORESTRY. 73d Cong., 1st sess., Senate Doc. 12, 2 v. 1933.

TABLE 3.—*Estimated annual cut of oak for various products* [1]

Product	Approximate quantity cut	Equivalent in lumber
		Million board feet
Lumber	1,507,000,000 board feet	1,507
Railroad ties hewed [2]	11,385,000 ties	338
Fuel wood	8,000,000 cords	600
Cooperage [3]	Tight barrels: 85,000,000 staves 6,000,000 sets of heading	109
	Slack barrels: 4,000,000 staves 700,000 sets of heading	3
Mine timbers, round	30,000,000 cubic feet	120
Fence posts	40,000,000 posts	20
Veneer	10,000,000 feet log scale	12
Piling	120,000 pieces	12
Export logs and timbers	5,000,000 board feet	5
Cross arms, brackets, and insulator pins		4
Poles	4,000 poles	
Distillation wood	70,000 cords	21
Tanbark	50,000 cords bark	
Total		2,751

[1] The figure shown for lumber is the average annual production for the period 1933–42. Figures for cross ties, cooperage, and veneer are averages of two or more of the latest years for which records are available. Figures for the other items are based on best available estimates.

[2] Sawed ties included in lumber.

[3] The following factors were used in converting staves and heading into board feet: 3 slack staves=1 board foot; 1 set slack heading=2 board feet; 1 tight stave=1 board foot; and 1 set tight heading=4 board feet.

The wood is in general heavy, hard, stiff, and strong and has high shock-resisting ability (table 4). Tests indicate that the white oaks as a group are about equal in strength to the red oaks as a group. Rapid-growing, second-growth oak is generally stronger, harder, and tougher than old-growth timber which is finer grained, softer, more easily worked, and takes a finer finish. Live oak is considerably above the other oaks in strength properties. Oak has a large shrinkage in drying, and seasoning must be done carefully to avoid checking and warping.

The average weight of the white oak group is 47 pounds per cubic foot. Live oak is not included in this average, as it is markedly heavier than the other oaks and is little used for lumber. The average weight of the red oak group is 45 pounds per cubic foot.

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[14] Chestnut oak, which is in the white oak group, is an exception. In this wood only occasional closed or partly closed pores are found.

[15] Pith rays are narrow bands of cells which grow radially within the tree. They may be likened to double-edged knife blades thrust toward the center of the tree so as to crowd between the vertical cells.

In machining properties the oaks have a high rank as indicated in table 5.

TABLE 4.—*The average weights of the various white oaks and red oaks*

White oak group	Weight of air-dry wood (12-percent moisture)	Red oak group	Weight of air-dry wood (12-percent moisture)
	Pounds per cubic foot		*Pounds per cubic foot*
White oak	48	Black oak	43
Chestnut oak	46	Northern red oak	44
Post oak	47	Southern red oak	41
Overcup oak	(1)	Scarlet oak	47
Swamp chestnut oak	47	Water oak	44
Bur oak	45	Willow oak	49
Chinquapin oak	(1)	Blackjack oak	(1)
Swamp white oak	50	Pin oak	44
Live oak	62	Swamp red oak	48
		Shumard oak	(1)
		Laurel oak	44

(1) Information not available.

TABLE 5.—*Percentage of pieces in good to excellent condition after being subjected to the following machining operations*

	Planing	Shaping	Turning	Boring	Mortising	Sanding	Steam bending
White oaks	84	28	85	95	100	83	91
Red oaks	91	21	84	99	100	81	86
Average of 25 species of hardwoods	61	25	79	89	70	45	62

In all operations except shaping, both the white oaks and red oaks are considerably above the average of the 25 hardwoods tested. In shaping (one of the most exacting operations) the white oaks were slightly above the average, and the red oaks slightly below.

In resistance to decay, the white oaks[16] are classed as intermediate, together with dense southern pine and dense Douglas-fir, and placed in the second of five groups of woods arranged in the order of their durability. The less durable red oaks are classed with yellow birch, sugar maple, and the spruces in next to the lowest of the five groups. Oak is capable of taking a wide range of finishes, varying from the garish "golden oak," common 40 years ago, to the quiet brown finishes now frequently used.

The bark of several of the oaks, especially tan oak from California, chestnut oak, and black oak,[17] contains a comparatively high percentage of tannin, used in the treatment (tanning) of animal skins to make them strong, flexible, water resistant, and lasting.

When oak wood is heated in closed retorts or ovens in the absence of air (distillation process), charcoal and certain other products are formed. When subjected to further processes, these products yield wood alcohol (methanol) and acetic acid.

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[16] Refers to heartwood. The sapwood of all species is low in resistance to decay.

[17] The extract called "quercitron" obtained from black oak is essentially a dyestuff and not a tanning material.

TABLE 6.—*Oak used in the manufacture of wooden products*

[Thousands of board feet]

Product	1912	1928	1933	1940
Airplanes	4	7	10	7
Agricultural implements	69, 346	23, 798	3, 536	9, 121
Boot and shoe findings	3	----------	----------	188
Boxes, baskets and crating	56, 362	68, 218	[1] 38, 954	[1] 208, 962
Boxes, cigar and tobacco	403	17	2, 493	46
Butchers' blocks	[2] 12	----------	----------	----------
Car construction and repair	305, 277	139, 648	31, 857	46, 972
Caskets and burial boxes	7, 544	11, 800	6, 435	8, 352
Conduits, pumps, and wood pipe	566	----------	----------	1
Dairy, poultry, and apiary supplies	(3)	679	725	597
Dowels and skewers	[4] 77	900	----------	64
Electrical equipment	4, 936	1, 879	150	177
Fixtures	62, 682	21, 318	2, 946	6, 614
Flooring	(5)	(5)	155, 347	946, 395
Furniture	566, 327	148, 279	79, 877	98, 380
Handles	12, 951	3, 948	3, 246	3, 020
Instruments, musical	20, 638	2, 340	200	240
Instruments, professional and scientific	372	291	46	317
Ladders	(3)	(3)	17	141
Laundry appliances	427	345	247	202
Machinery	21, 579	604	47	327
Patterns and flasks	182	452	716	592
Playground equipment	2, 577	1, 125	167	158
Plumbers' woodwork	14, 031	4, 507	1, 049	----------
Printing material	272	8	19	----------
Radio and phonograph cabinets	(6)	(6)	28	29
Refrigerators	31, 351	20, 129	1, 091	935
Rollers, shade and map	294	57	----------	327
Sash, doors, general millwork	[7] 520, 052	[7] 802, 410	[8] 17, 711	[8] 38, 181
Sewing machines	19, 106	2, 757	1, 724	559
Ship and boat building	32, 382	17, 154	6, 204	15, 451
Shuttles, spools, bobbins, looms	[9] 39	[9] 2	(9)	73
Signs, scenery, displays	12	112	159	4
Sporting and athletic goods	2, 497	993	164	129
Surgical supplies	----------	----------	----------	----------
Tanks	5, 042	256	936	326
Toys	1, 444	407	262	606
Trunks and valises	4	----------	3	44
Vehicles, motor	(10)	106, 025	86, 355	38, 434
Vehicles, nonmotor	212, 918	27, 047	6, 101	7, 014
Woodenware and novelties	11, 872	1, 244	502	3, 520
Total	1, 983, 584	1, 408, 756	449, 324	1, 436, 555

[1] Figures for 1933 and 1940 include oak used for boxes, baskets, and crating by plants not classified as manufacturers of wooden products and which were not included in 1912 and 1928. The amounts included for nonmanufacturers of wooden products were: 1933—27,094,000 board feet, and 1940—159,297,000 board feet.

[2] Includes skewers.

[3] Included in "Woodenware and novelties."

[4] Does not include skewers.

[5] Included in "Sash, doors, and general millwork."

[6] Included in furniture.

[7] Includes planing mill products such as flooring, siding, ceiling, etc.

[8] Planing mill products not included in 1933 and 1940 canvasses as in 1912 and 1928, except flooring, which is listed separately.

[9] Does not include looms.

[10] Included in "Vehicles, nonmotor."

Principal uses.—Oak is used principally for lumber, railroad ties, fuel wood, cooperage, and mine timbers. Lumber is the outstanding use in both amount and value. Much of it is remanufactured into flooring, furniture, motor-vehicle parts, car construction, general millwork, and boxes and crates. Other uses which consume smaller amounts of lumber include caskets and coffins, ship and boat building, nonmotor vehicles, agricultural implements, fixtures, woodenware and novelties, and handles. Of the lumber not remanufactured, a large proportion is used in building construction and some is exported.

The hardness and wearing qualities of oak, combined with ability to stay in place and handsome appearance, have made it the principal flooring wood for residences. For striking effects quarter-sawed flooring is used. For more subdued effects plain-sawed material is preferable.

Oak is one of the oldest furniture woods. Its abundance, hardness, strength, machining properties, and appearance, as well as its adaptability to various kinds of finish, qualify it well for all grades of furniture. In 1940, the leading furniture wood from the standpoint of quantity used was sweetgum with a consumption nearly three times that of oak, which ranked sixth. Yellow-poplar, maple, water tupelo, birch, and sweetgum were all ahead of oak in the quantity used for furniture.

Oak is the leading wood used in the construction of motor vehicles, but the amount has decreased markedly in recent years because of the substitution of metal. Oak has been a preferred wood for ship and boat construction ever since the days of England's "wooden walls"—a term applied to the ships of oak built for the British Navy. The first forest land reserved by the United States Government consisted of an island in the Gulf of Mexico which contained a stand of live oak especially suitable for ship knees.

For railroad ties, oak has always been the leading wood. The white oaks are sometimes used without preservative treatment. The less durable red oaks are nearly always treated. White oak is the outstanding wood for tight barrels, kegs, and casks for whiskey, beer, and wine. The flavor and palatability of whiskey and wine are improved by storage in oak barrels, and no satisfactory substitute has as yet been found. The availability and strength of oak have made it the leading wood for mine timbering. Consumption for this purpose has, however, decreased to some extent in recent years.

Table 6 gives the amounts of oak lumber used in the manufacture of wooden products for the years 1912, 1928, 1933, and 1940, including material in the form of lumber, veneer, and logs and bolts. The material is made up largely of lumber, with much smaller amounts of veneer and some short logs and bolts, which are not sawed into lumber but into squares, and other forms of the approximate sizes needed for furniture or other wooden products.

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